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DERWENT-WEEK: 197946

TITLE: Applying cermet or ceramic layers to metal substrates - by spraying a layer of the compsn. and compacting the layer under isostatic conditions at high temp. and pressure

PATENT-ASSIGNEE: SKF TRADING BV[SKFK]

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NL 7804454 A	October 30, 1979		000	N/A
CA 1124586 A	June 1, 1982		000	N/A
DE 2962269 G	April 15, 1982		000	N/A
EP 5285 A	November 14, 1979		000	N/A
EP 5285 B	March 17, 1982		000	N/A
JP 54142220 A	November 6, 1979		000	N/A
JP 88006630 B	February 10, 1988		000	N/A
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ABSTRACTED-PUB-NO: NL 7804454A

BASIC-ABSTRACT:

Hard, dense, wear-resistant layers of cermets or ceramics are applied to metal
articles by spraying a matrix material and hard particles of cermets or ceramic
material followed by isostatic compaction of the sprayed layer at >=1000
degrees C and a pressure of >=1000 bar for >=1/2 hr. The high pressure
compaction gives a very dense coating with greatly improved adhesion to the
substrate.

The matrix material is e.g. of Co and/or Ni and the hard particles are of a
ceramic material or a cermet such as WC. A pref. compsn. is of 83-94wt.% WC
with the remainder Co. Compaction of the coating is carried out for 1/2-2 hrs.
at 1000-1400 degrees C and 1000-1800 bar.

TITLE-TERMS: APPLY CERMET CERAMIC LAYER METAL SUBSTRATE SPRAY LAYER COMPOSITION
COMPACT LAYER ISOSTATIC CONDITION HIGH TEMPERATURE PRESSURE

ADDL-INDEXING-TERMS:
COBALT@ NICKEL@ TUNGSTEN CARBIDE

DERWENT-CLASS: L02 M13 P42 P53

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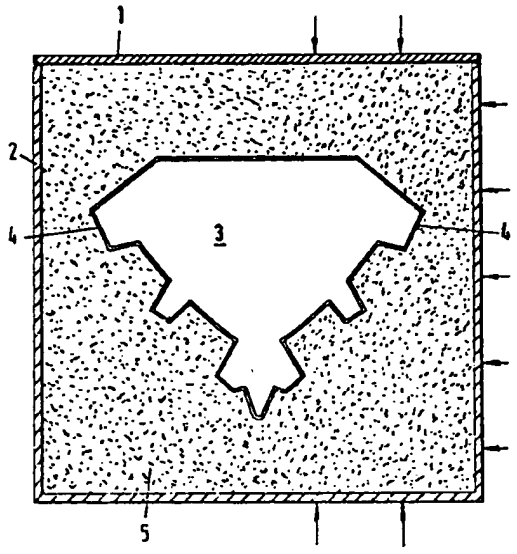
(54) **Process for applying a dense layer of hard alloys or cermets to a metal object; metal objects coated with a dense layer of hard alloys or cermets.**

(57) A process for applying a dense, hard and wear-resistant layer of cermets or ceramic material to a metal object which can have a complicated shape by the spraying on of a matrix material and hard particles of cermets or ceramic material, followed by consolidation of the sprayed-on layer by hot isostatic compaction of the combination at high temperature and pressure during at least ½ hour.



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TITLE MODIFIED
see front page

Process for Applying a Dense Layer of Hard Alloys or Cermets to a Metal Object

The invention relates to a process for applying a dense, hard and wear-resistant layer of cermets or ceramic material to a metal object by the spraying on of a matrix material and hard particles of cermets or ceramic material, followed by consolidation of the sprayed-on layer at high temperature and pressure.

British Patent 1,451,113 discloses a process for spraying a layer on a metal object, such layer consisting of a metal or an alloy, which may contain ceramic materials, or so-called cermets. In spraying by known methods, for example flame spraying or plasma spraying of powdered materials, a porous layer is obtained. In many cases, the adhesion of this layer to the base material is found unsatisfactory, and therefore the said patent proposes consolidating the porous layer by fusing the binder metal present therein under vacuum, thus reducing the porosity. To combat oxidation, this fusion is carried out under vacuum. According to the patent, good results are obtained by this method if the layer consists of 50 percent by weight of tungsten carbide in a matrix of a nickel-chromium alloy serving as binder metal.

As the content of binder metal in the layer decreases, and the content of hard particles accordingly increases, it seems to become more and more difficult to consolidate the layer by fusing the binder metal, and at a binder metal content of 30 percent or less, it becomes practically impossible.

German Letters of Disclosure 1,783,061 propose application of a comparable dense layer by built-up welding, using a tubular or rod welding electrode containing a binder metal and tungsten carbides. Such an electrode, according to the specification, preferably contains 30-40 percent.

by weight of binder metal and 70-60 percent by weight of carbide particles. During welding, this material is further mingled with some quantity of molten base material. According to the German specification, the binder metal must contain at least one of the metals Co, Ni, Fe or Cr as chief constituent.

By this method also, it is not possible to apply a dense layer to a metal object such that the layer consists of more than 70 percent by weight of ceramic or cermet particles, such as hard metal carbides, for example tungsten or titanium carbide, or other hard materials. In a layer with so high a content of hard particles, a cohesive and/or adhesive bond cannot be improved by internal fusion.

According to the invention, in a process of the type initially referred to, the consolidation of the sprayed-on porous layer is accomplished by isostatic compaction at a temperature of at least 1000°C and a pressure of at least 1000 bars, for at least one half hour.

In this way it is possible to obtain an applied layer of high density and markedly improved bonding to the base material.

The process according to the invention is especially suitable for applying a layer of tungsten carbide/cobalt to a forged, cast or sinter[illegible] core or similar base material. Cermets of other metals or ceramic materials may alternatively be used, for example TiC or Si_3N_4. As binder metal, a metal or an alloy consisting predominantly of Ni, Co, Fe or Cr may be used. Preferably cobalt or an alloy of cobalt and nickel (Co/Ni) is used. The proper choice of course depends partly on the base material used, to which the applied layer must bond well.

The layer is applied by spraying on of a powder mixture containing the binder metal and the particles in the desired proportion for the layer. This spraying may be carried out in conventional manner, for example by flame spraying or plasma spraying, a porous layer being formed in either case. The objects may be completely or only partly coated with the sprayed

layer. Depending on the desired thickness of layer, the coating material may be applied in one or several thicknesses. If desired, the successive layers may differ from each other in composition.

If necessary, the surface may then be finished smooth. In most faces, however, this can be omitted because the roughness of the surface after consolidation is chiefly determined by the grain size of the pressure transmitting medium. If the proper grain size is used, the smoothness of the surface will be sufficient in most cases even without finishing. A grain size of 0.10-0.25 mm is very satisfactory for many purposes.

According to a preferred form of the invention, a mixture containing at least 7 percent by weight of cermet particles is used for the sprayed-on layer, and preferably a mixture consisting of 83-94 percent by weight of tungsten carbide, remainder cobalt.

The thermal expansion coefficients of cermets or ceramic materials differ appreciably from those of metals. To prevent the applied layers from cracking loose as a result of thermal stresses during cooling at the end of the consolidating operation, it is preferable to vary the content of cermets or ceramic materials in the direction of depth by applying the coating layer in two or more steps, the content of binder metal being varied from one sprayed-on layer to another.

The invention likewise relates to metal objects completely or partially coated with a dense layer consisting of a binder metal and so-called cermet particles or ceramic materials and characterized in that the dense coating layer consists of at least 70 percent by weight of the hard particles, remainder binder metal.

The invention relates also to such metal objects in which the layer consists of 83-94 percent by weight of cermet particles, in particular a tungsten carbide/cobalt composition.

More specifically also, the invention relates to objects of the said type

generally in which the content of binder metal in the applied hard layer varies with the distance from the base metal, and in particular to such coated objects in which the content of binder metal in the layer decreases with increasing distance from the base material.

The invention will now be further illustrated with reference to figures, Fig. 1 schematically representing an object produced according to the invention, and Figs. 2 and 3 showing photographs of a compacted layer before and after use of the invention.

After spraying on of the layer 4, the coated object 3 is placed in a comparatively thin-walled holder 2, for example of low-alloy steel. Then the holder is completely filled with a pressure transmitting medium 5 and closed gastight with a cover 1. Then the holder 2 is placed in a hot isostatic press (not shown) in which the holder is heated to the consolidating temperature, which is at least 1000°C, preferably 1000-1400°C. The temperature during this operation is always such that the consolidation takes placed in the solid phase. At this temperature, the binder metal is not melted, but some sintering does occur. Simultaneously with the raising of the temperature, or after the desired temperature has been reached, the gas pressure in the press is raised to at least 1000 bars, preferably up to 1800 bars. This diminishes the volume of the holder 2, and the gas pressure is transmitted by way of the pressure transmitting medium 5 to the object 3 with sprayed-on layer 4. Under the influence of this temperature and pressure, the layer 4 is consolidated, while at the same time a diffusion bond is formed with the base material 3. This process takes at least one half-hour, counting from attainment of the consolidation temperature to the commencement of cooling. Preferably the operation is continued for 1/2 to 2 hours. Then the temperature and pressure are allowed to return to the level of the surroundings, after which the object is removed from the holder 2.

Fig. 2 shows a photograph of a plasma-sprayed layer 4A on a base material 3A before the invention has been applied to the object. After the process ac-

cording to the invention, the picture of Fig. 3 is obtained, which clearly shows that 1) layers 3 and 4 have attained maximum density, 2) an optimum diffusion bond 6 has been formed between layers 3 and 4.

- Claims -

1. Process for applying a dense, hard and wear-resistant layer of cermets or ceramic material to a metal object by spraying-on of a matrix material and hard particles of cermets or ceramic material, followed by consolidation of the sprayed-on layer at high temperature and pressure, characterized in that the sprayed-on layer is consolidated by isostatic compacting at a temperature of at least 1000°C and a pressure of at least 1000 bars for at least 1/2 hour.

2. Process according to claim 1, characterized in that cobalt and/or nickel is used as binder for the sprayed-on layer.

3. Process according to claims 1 to 2, characterized in that a layer containing ceramic particles is sprayed on.

4. Process according to claims 1 to 2, characterized in that cermet particles are used in the sprayed-on layer.

5. Process according to claims 1 to 4, characterized in that a mixture containing at least 70 percent by weight of cermet particles, for example tungsten carbide, is used for the sprayed-on layer.

6. Process according to claim 5, characterized by use of a sprayed-on layer consisting 83-94 percent by weight of tungsten carbide, remainder cobalt.

7. Process according to claim 6, characterized in that the consolidation is carried out during a period of 1/2 to 2 hours at a temperature of 1000-1400°C and a pressure of 1000-1800 bars.

8. Process according to claims 1 to 7, characterized in that the coating layer is applied in two or more steps, the content of binder metal in the sprayed-on layers being so varied as to prevent the layers from cracking loose because of differences in coefficient of expansion.

9. Metal objects completely or partially coated with a dense layer con-

sisting of a binder metal and high-melting, hard cermet particles or ceramic particles, characterized in that the dense coating layer, consisting of at least 70 percent by weight of the hard particles, remainder a binder metal, is isostatically compacted.

10. Metal objects according to claim 9, characterized in that the layer consists of 83-94 percent by weight of a cermet material.

11. Metal objects according to claim 9 or 10, characterized in that the cermet is a tungsten carbide.

12. Metal objects according to claims 9 to 11, characterized in that the binder metal consists of cobalt.

13. Metal objects according to claims 9 to 12, characterized in that the layer consists of 83-94 percent by weight of tungsten carbide and 17-6 percent by weight of cobalt.

14. Metal objects according to claims 9 to 13, characterized by the presence of an optimum diffusion bond between the layer and the base material.

15. Metal objects according to claims 9 to 14, characterized in that the content of binder metal in the layer varies with the distance from the base material.

16. Metal objects according to claim 15, characterized in that the content of binder metal in the layer decreases with increasing distance from the base material.

FIG.1

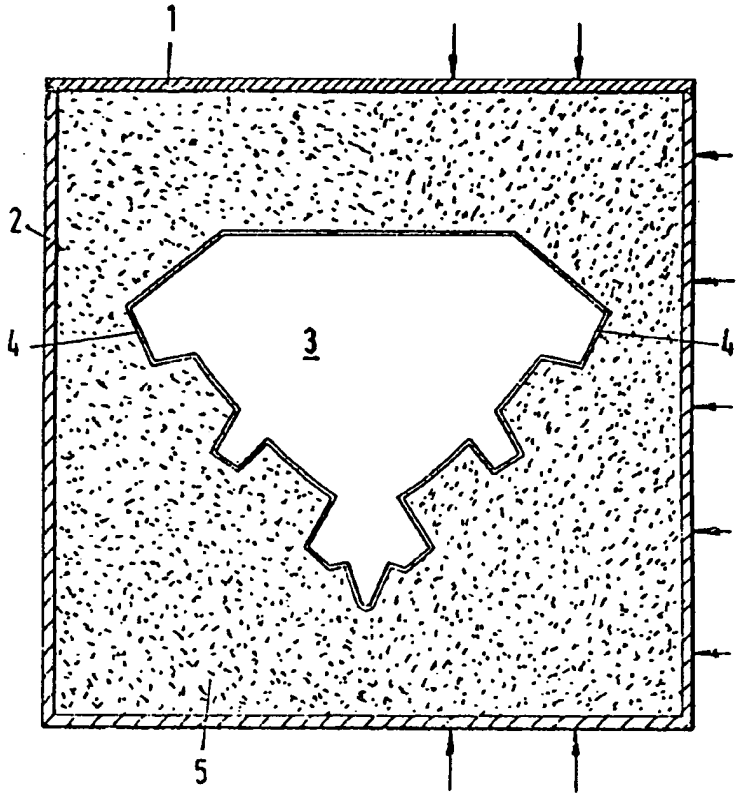
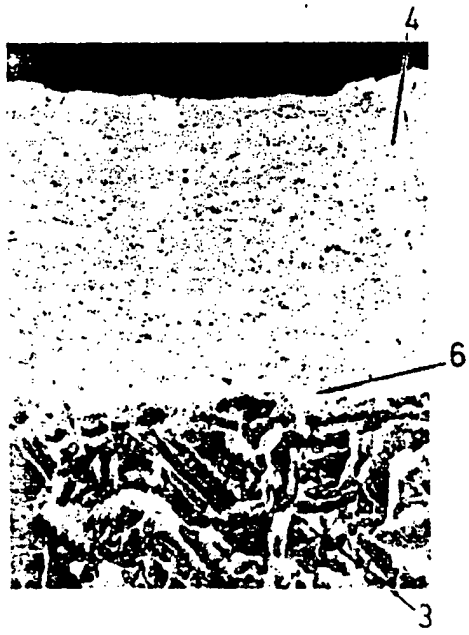


FIG.2

FIG.3



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EUROPEAN SEARCH REPORT

Application number
EP 79 20 0170

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	FR - A - 1 434 158 (SOCIETE DE FABRICATION) * abstract 4; pages 2,3; example 2; figure 2 * ---	1	C 23 C 7/00
	GB - A - 1 367 762 (ASSOCIATED ENGINEERING) * claim 1 * ---	1	TECHNICAL FIELDS SEARCHED (Int.Cl.³)
A	NL - A - 6 709 916 (SHELL) ---		C 23 C 7/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	04-07-1979	DEVISME

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EP 0 005 286 A1